COUNTERCELLS

SEMICONDUCTOR TYPE

REQUIREMENTS AND ADJUSTING PROCEDURES

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1. GENERAL

1.01 This section covers the general requirements and adjusting procedures for selenium- and silicon-type countercells. Countercells (CEMF) are used in battery discharge circuits and power plants to reduce the load voltage to a desired value.

1.02 The reasons for reissuing this section are listed below. Revision arrows are used to emphasize the more significant changes. This reissue does affect the Equipment Test List.

(a) To add a table of contents

(b) To add paragraph 1.07 and associated note and admonition

(c) To add Figure 1

(d) To change rating of the KS-20019, L1, countercell to Manufacture Discontinued

(e) To add the KS-20019, L3, countercell in subparagraphs 2.01(b) and 2.03(b)

(f) To remove the warning admonishment associated with paragraph 2.04.

1.03 Solid-state selenium and silicon countercells are designed to replace wet alkaline (KS-5170) countercells. The wet alkaline countercell generates explosive gases which present a potential fire hazard. Selenium countercells eliminate the fire hazard of wet countercells; however, the plate voltage of selenium countercells increases with age. Silicon countercells eliminate the fire hazard of wet countercells and the aging characteristic of selenium countercells. Should the silicon countercell fail, due to abnormal operating conditions, the countercell will short-circuit and thereby prevent the possibility of an open battery string.

Note: Silicon countercells (KS-19200, KS-20019, KS-20637, and KS-20784) are preferred to selenium countercells (KS-15928) in all new installations, and in old installations when replacement of selenium countercells becomes necessary.

1.04 The KS-20784, L1, silicon countercell is designed primarily for use in the 131-type power

plant. The KS-20784, L1, countercell is also used as a replacement for the KS-19200, L1, silicon countercell and the KS-5170, L101 and L202, wet countercells. The KS-20784, L1, countercell is rated 30 amperes.

1.05 ***Silicon Countercell Advantages Over Selenium Countercell:*** The advantages of silicon countercells are as follows:

(a) Voltage does not vary with age. (Plate voltage of selenium cell increases with time, requiring an aging adjustment.)

(b) Available in higher amperage ratings.

(c) Requires less space.

(d) Longer service life.

(e) More reliable.

(f) Designed to "fail short" under abnormal operating conditions, thus assuring continuation of power to the load. (Selenium cells may "fail open" and thus require an additional protective circuit to guard against power failure to the load.)

1.06 The requirements and adjustments covered in this section shall be followed except as modified by applicable sections covering specific power plants.

Caution: Avoid possible service interruption due to opening countercell connections.

1.07 Whenever cell connections are to be opened, take precautions to ***maintain the circuit*** so that the office will not be lost by accidental opening of the shunt while the countercell connections are open. If the plant does not include switching facilities for this purpose, a suitable shunt can be constructed. As a suggestion, this shunt may be made up with two 6-foot lengths of wire (see Section 171-123-101 for proper wire size), or the countercell wiring can be connected as shown in Fig. 1.

Note: When disconnecting the countercell with blocked contactor shorting the terminals (Fig. 1), only the nut contacting the outermost side of the countercell terminal should be removed leaving the circuit connectors bolted together.

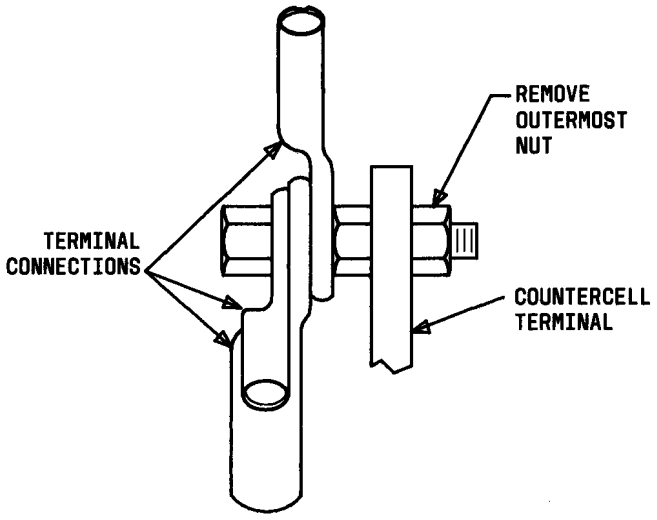

Fig. 1—Countercell Bypass Connection

2. REQUIREMENTS

2.01 The voltage drop limits in the forward direction (see Fig. 2) are as follows:

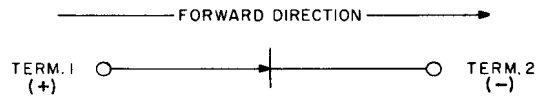

Fig. 2—Schematic of Countercell

(a) ***Selenium (KS-15928, L1—12.5 Amperes and L2—160 Amperes) Countercells:*** The forward voltage drop in selenium cells is 2.5 volts maximum and 1.6 volts minimum when used individually or connected in parallel. The limits for series-connected arrangements are determined by multiplying the number of countercells connected in series by the maximum and minimum limits for an individual countercell.

(b) ***Silicon (KS-19200, L1—15 Amperes and KS-20019, L1 and L3—40 Amperes) Countercells:*** The forward voltage drop is 1.0 volt per diode maximum and 0.65 volt per diode minimum when used individually or connected in parallel. The limits for series-connected arrangements are determined by multiplying the number

of diodes connected in series by the maximum and minimun limits for an individual diode.

Note: The KS-20019, L1, countercell is rated Mfr Disc and is replaced by the KS-20019, L3, countercell.

(c) ***Silicon (KS-20637, L1—120 Amperes and L2—400 Amperes) Countercells:*** The nominal voltage drop is approximately 2.0 volts when connected individually or in parallel. The maximum voltage drop across the terminals is 2.85 volts with full rated current (L1, 120 amperes; L2, 400 amperes) flowing through the countercell. The minimum voltage drop across the terminals is 1.7 volts with at least 4 amperes (L1 cells) or 5 amperes (L2 cells) flowing through the countercell. The voltage drop requirement applies to an ambient temperature range of 10°C to 40°C.

(d) ***Silicon (KS-20784 L1—30 Amperes) Countercell:*** The KS-20784, L1, countercell produces a voltage drop of approximately 2 volts dc. The maximum voltage drop across the terminals is less than 2.85 volts with a full rated current of 30 amperes flowing through the countercell. The minimum voltage drop across the terminals is 1.75 volts with at least 1 ampere flowing through the countercell. The voltage drop requirement applies to an ambient temperature of 10°C to 40°C.

2.02 The maximum voltage drop shall not be attained at any time other than during peak office load conditions. (See paragraph 3.01 for corrective adjustment on selenium countercells only.)

2.03 The minimum voltage drop across the countercell may be less than the minimum values given in paragraph 2.01 if the office load current drain is less than the following:

(a) ***Selenium (KS-15928, L1 through L7)*** **Countercells**—10 percent of their ampere rating.

(b) ***Silicon (KS-19200, L1, and KS-20019, L1) Countercells***—1 percent of their ampere rating.

(c) ***Silicon (KS-20637, L1 and L2)*** **Countercells**—4 amperes for L1 and 5 amperes for L2.

(d) ***Silicon (KS-20784, L1) Countercell***—1 ampere.

Note: Some lightly loaded power plants may require dummy loads to prevent less than minimum load conditions.

2.04 ***Connections (Fig. 2):*** The difference between connecting negative and positive battery plants are as follows:

Caution: Semiconductor countercells may be damaged if not connected to the proper polarity.

(a) For negative battery plants (positive ground), the load shall be connected to terminal 1 of the countercell.

(b) For positive battery plants (negative ground), the load shall be connected to terminal 2 of the countercell.

Note: Terminal 1 is usually marked with black, and terminal 2 with red.

3. ADJUSTING PROCEDURES

3.01 After being in service over a period of time, selenium countercells will "age," developing a voltage drop in excess of 2.5 volts during peak office load. When this occurs, an aging adjustment shall be made by relocating the copper bushing provided for this purpose. (See Fig. 3 and 4.)

Danger: Insulated wrenches should be used in all cases where there is possibility of electrical hazards.

3.02 No aging is anticipated for silicon countercells. Consequently, no aging adjustment will be required. (See Fig. 5 through 9.)

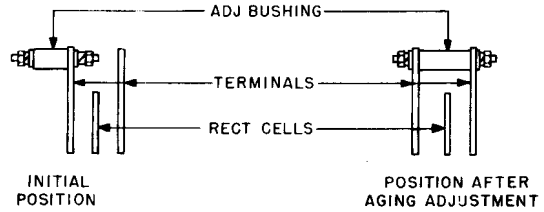

Fig. 3—Aging Adjustment (Selenium Countercell)

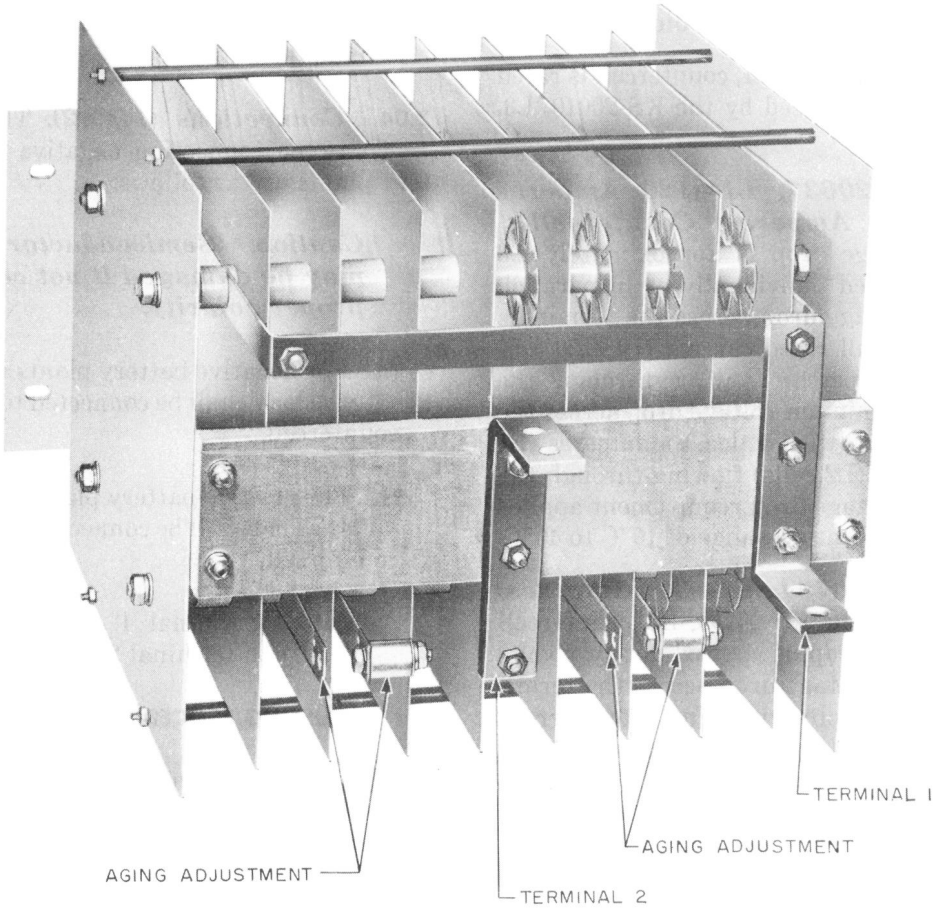

Fig. 4—Typical Selenium Countercell

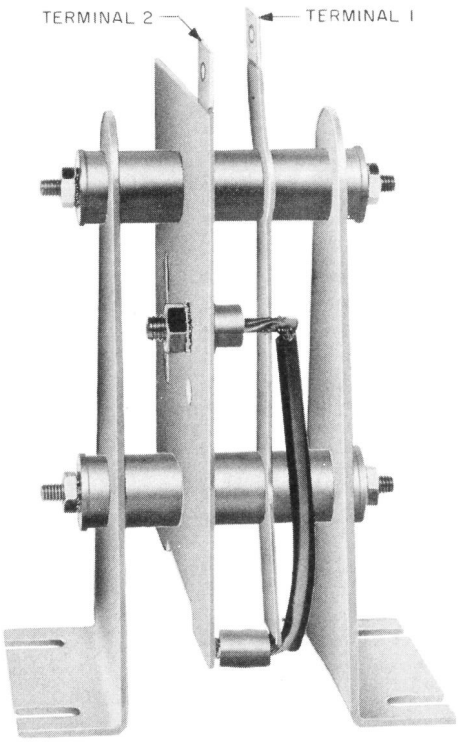

Fig. 5—Typical Silicon Countercell

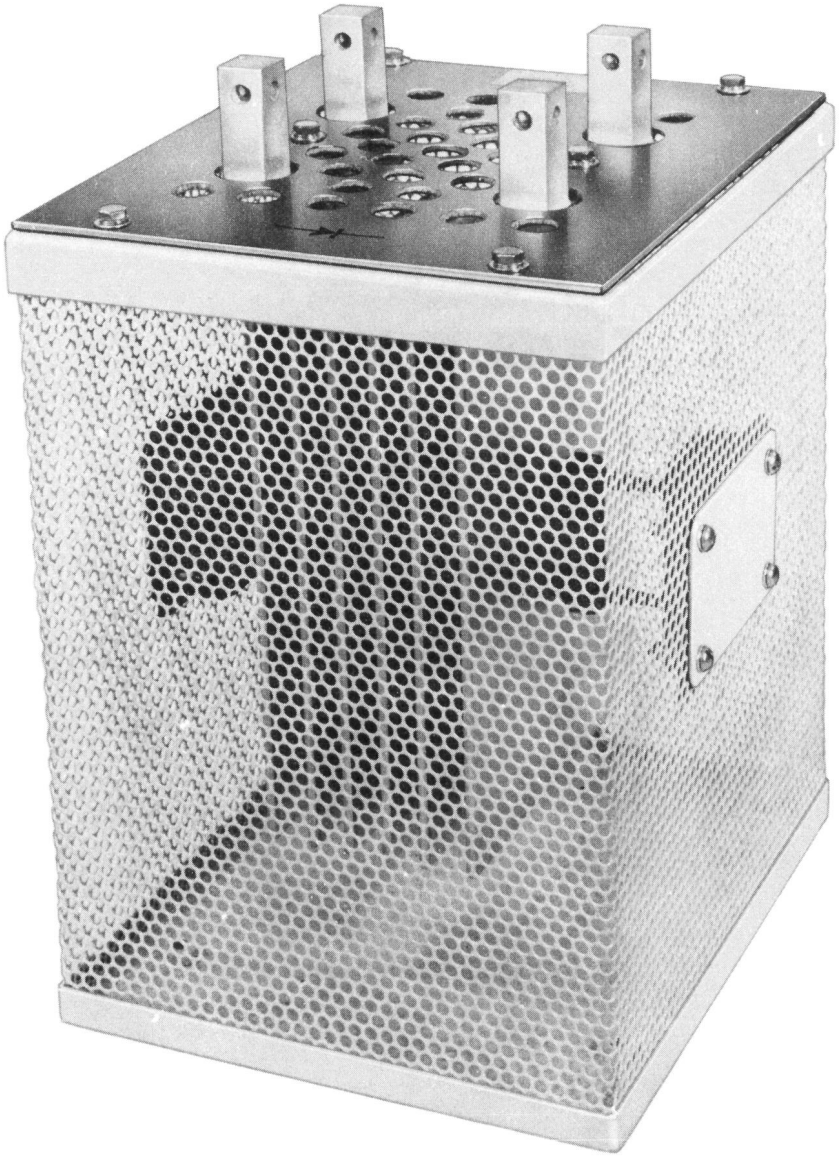

Fig. 6—KS-20637, L1, 120 Ampere Silicon Countercell

Fig. 7— KS-20637, L2, 400-Ampere Silicon Countercell

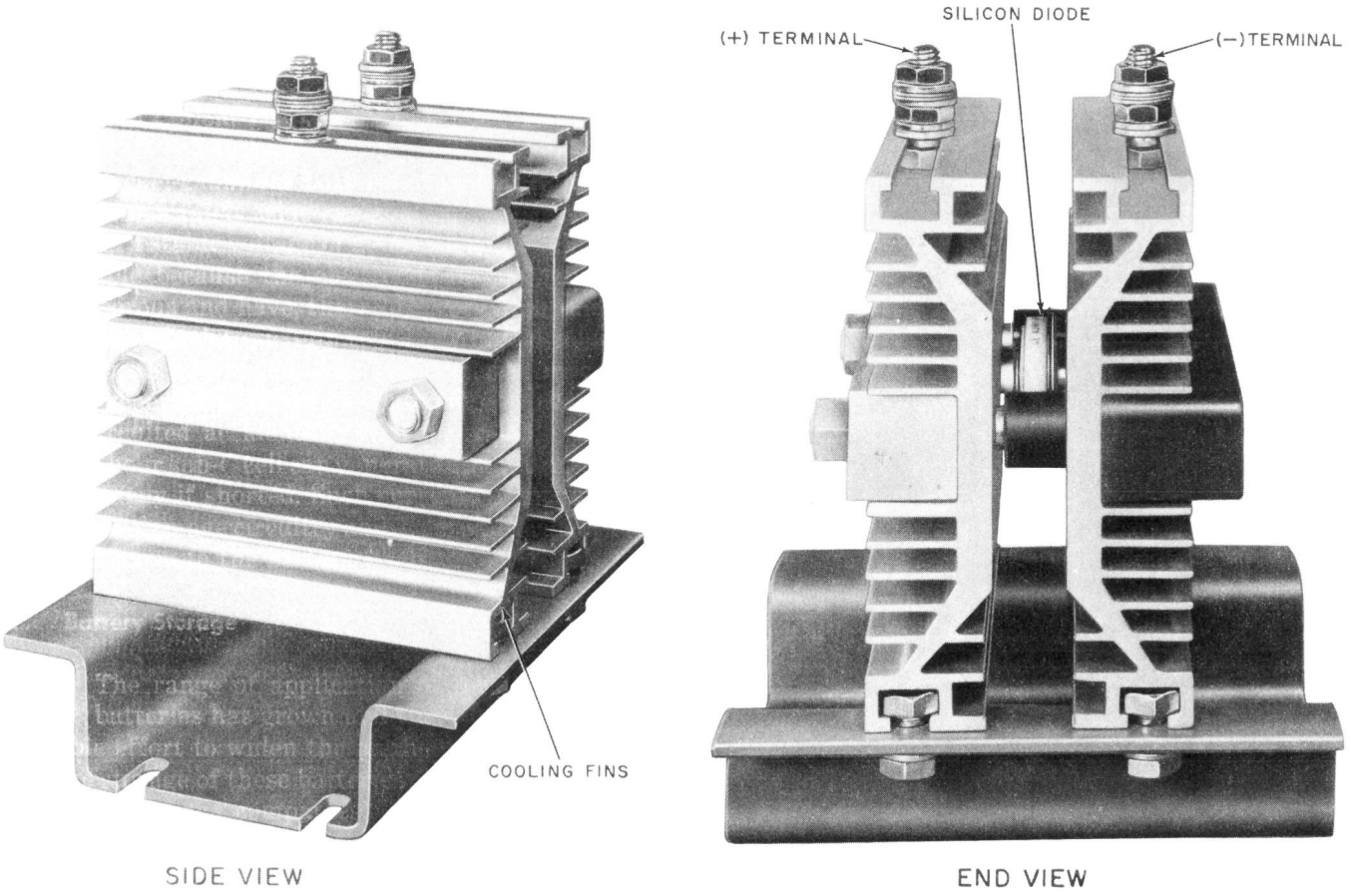

Fig. 8— KS-20784, L1, 30-Ampere Silicon Countercell— General Electric Co

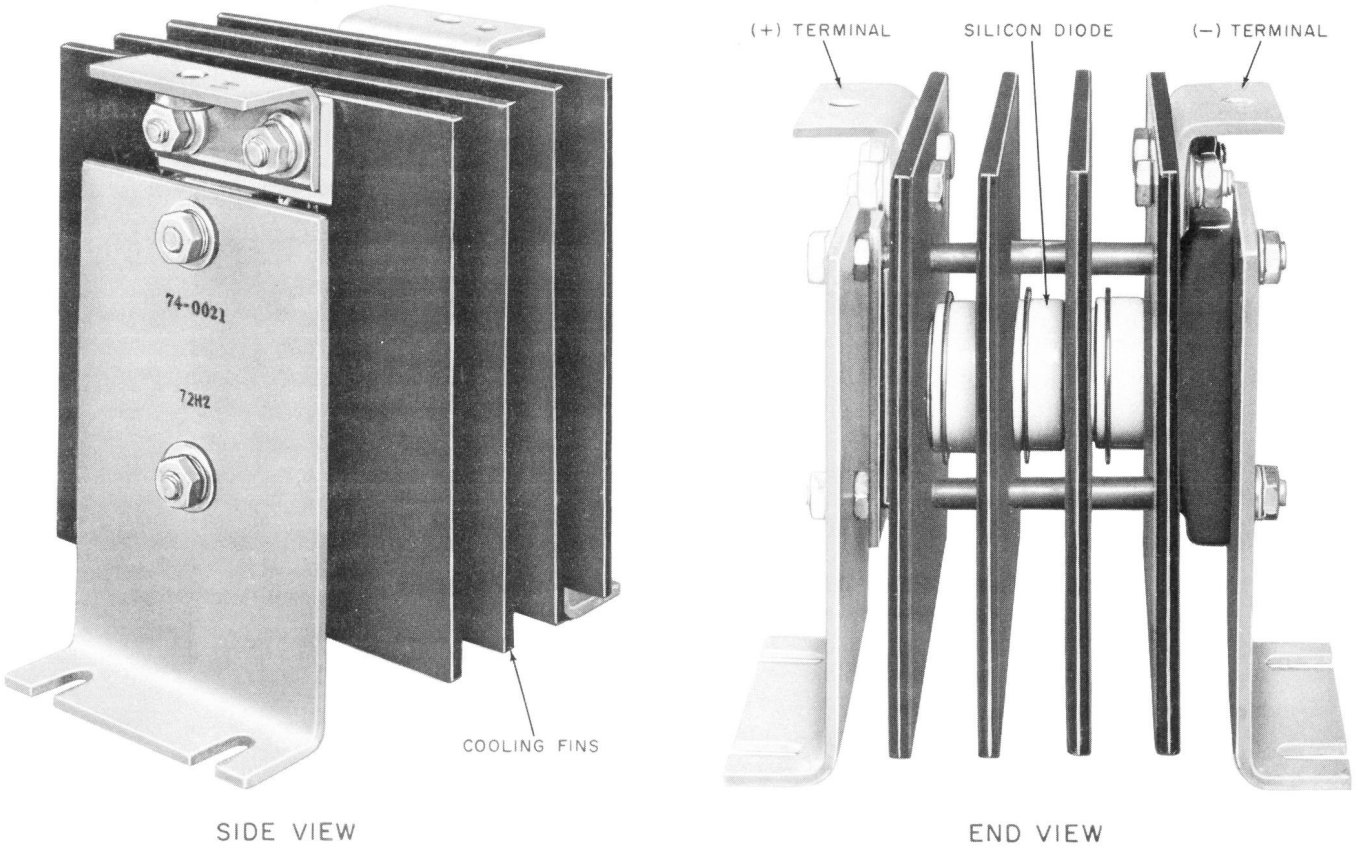

Fig. 9—KS-20784, L1 30-Ampere Silicon Countercell—International Rectifier